CLAIMS

1. A process for making fertilizer and thermoplastic-composite articles, the process comprising:
   (a) providing phosphate particulates,
   (b) contacting the phosphate particulates with sulfuric acid in the presence of water to produce phosphoric acid and a calcium sulfate,
   (c) separating at least a portion of the phosphoric acid from the calcium sulfate to produce a phosphoric acid product and a calcium sulfate byproduct,
   (d) admixing the calcium sulfate byproduct with a thermoplastic resin and an oil,
   (e) melt processing the admixture to produce a thermoplastic-composite composition,
   (f) forming the thermoplastic-composite composition to produce a thermoplastic-composite article.

2. The process of claim 1 wherein the process comprises dewatering the calcium sulfate byproduct prior to the admixing.

3. The process of claim 2 wherein the article is in the form of thermoplastic-composite lumber.

4. The process of claim 2 wherein the article is in the form of a sheet.

5. The process of claim 1 wherein the oil is epoxidized soybean oil.

6. The process of claim 1 wherein the thermoplastic resin is a polyolefin.

7. The process of claim 6 wherein the polyolefin is selected from the group consisting of polyethylene and polypropylene.

8. The process of claim 1 wherein the calcium sulfate byproduct composition comprises a calcium sulfate compound at a level of from 50 to 99 percent by weight based on the total weight of the byproduct composition.

9. A process for making useful products from byproducts of manufacturing phosphorous fertilizers, the process comprising:
   (a) providing a calcium sulfate byproduct made by contacting phosphate particulates with sulfuric acid in the presence of water to produce phosphoric acid and the calcium sulfate byproduct, and
   (b) melt mixing the calcium sulfate byproduct with a polyolefin to produce a thermoplastic-composite composition.

10. The process of claim 9 further comprising forming the thermoplastic-composite composition into a shaped article.

11. The process of claim 10 wherein the article is selected from the group consisting of sheets, lumber, poles, pilings, railroad crossties, car stops, utility pole cross arms, and tiles.

12. An article made by the process of claim 1.

13. An article made by the process of claim 10.

14. An article made by the process of claim 11.

15. A thermoplastic-composite composition comprising:

(a) a thermoplastic resin, and

(b) a phosphogypsum (calcium sulfate) composition comprising a calcium sulfate present at a level of from 50 to 99 percent by weight based on the total weight of the calcium sulfate composition.

16. The composition of claim 15 wherein the thermoplastic resin is a polyolefin.

17. The composition of claim 15 wherein the composition is made with a mixture comprising the thermoplastic resin, the phosphogypsum (calcium sulfate) composition, and an epoxidized oil.

18. The composition of claim 17 wherein the mixture comprises the thermoplastic resin in an amount of from 40 to 75 percent by weight based on the total weight of the mixture, the calcium sulfate composition in an amount of from 25 to 60 percent by weight based on the total weight of the mixture, and the epoxidized oil in an amount of from 0.5 to 2 percent by weight based on the total weight of the mixture.

19. The composition of claim 15 wherein the filler comprises an amount of a fluoro compound.

20. The process of claim 1, further comprising:

separating water from the calcium sulfate byproduct prior to admixing the calcium sulfate byproduct with the thermoplastic resin and the oil, wherein:

the oil is epoxidized soybean oil, and

the thermoplastic-composite composition comprises the thermoplastic resin in an amount of from 25 to 80 % by weight based on the total weight of the composition, the calcium sulfate byproduct being present in an amount of from 20 to 75 % by weight based on the total weight

of the composition, the functionalized oil being present at a level of from 0.5 to 10% by weight based on the total weight of the composition.

21. A process for making metallic concentrates and plastic articles, the process comprising:

(a) providing metallic ore particulates,

(b) contacting the particulates with reagent in the presence of water to produce coated particulates having a water repellent air avid coating to produce an interaction mass,

(c) agitating and aerating the interaction mass to form a (i) froth comprising floating metallic particles and (ii) an underflow comprising water and solid tailings,

(d) separating at least a portion of the froth from the underflow,

(e) bulk separating the water from the tailings,

(f) drying the tailings to produce a tailing composition comprising less than 1 percent by weight water, the tailing composition comprising (i) calcium carbonate, (ii) silica and (iii) lead sulfide,

(g) admixing the tailing composition with a thermoplastic resin,

(h) melt processing the admixture to produce a thermoplastic article,

22. The process of claim 21 wherein the article is in the form of plastic block.

23. The process of claim 21 wherein the article is in the form of a crosstie or car stop.

24. The process of claim 21 wherein the thermoplastic resin is a polyolefin.

25. The process of claim 24 wherein the polyolefin is selected from the group consisting of polyethylene and polypropylene.

26. The process of claim 21 wherein the tailing composition comprises (i) a calcium carbonate compound at a level of from 30 to 95 percent by weight based on the total weight of the tailing composition, (ii) a silica at a level of from 1 to 50 percent by weight based on the total weight of the tailing composition, and (iii) a lead sulfide at a level of from 0.005 to 0.3 percent by weight based on the total weight of the tailing composition.

27. A process for making a thermoplastic composition, comprising:

(a) contacting ore particulates comprising metallic sulfide particulates with a flotation reagent in the presence of water to produce an interaction mass comprising coated metallic sulfide particulates;

(b) aerating the interaction mass to cause flotation of the coated metallic sulfide particulates thereby producing a froth;

(c) separating the froth from an aqueous underflow comprising tailings, the tailings comprising calcium carbonate, silica, fluorspar, barium sulfate, zinc and lead; and

(d) microencapsulating the tailings by melt mixing the tailings with a polyolefin to form a thermoplastic composition.

28. The process of claim 27 further comprising forming the thermoplastic composition into an article.

29. The process of claim 27 wherein the article is a car stop.

30. The process of claim 27, wherein the article is an ocean wave energy absorber.

31. An article made by the process of claim 21.

32. An article made by the process of claim 28.

33. A thermoplastic composition comprising:

(a) a thermoplastic polyolefin resin, and

(b) a tailing composition comprising (i) a calcium carbonate present at a level of from 30 to 95 percent by weight based on the total weight of the tailing composition, (ii) a silica present at a level of from 1 to 50 percent by weight based on the total weight of the tailing composition, and (iii) a lead sulfide present at a level of from 0.05 to 0.3 percent by weight based on the total weight of the tailing composition.

34. The composition of claim 33 wherein the composition is made from a mixture of the thermoplastic polyolefin resin, the tailing composition, and an epoxidized oil.

35. The composition of claim 34 wherein the mixture comprises the thermoplastic resin in an amount of from 40 to 75 percent by weight based on the total weight of the mixture, the tailing composition in an amount of from 25 to 60 percent by weight based on the total weight of the mixture, and the epoxidized oil in an amount of from 0.5 to 2 percent by weight based on the total weight of the mixture.

36. A railroad tie made by melt processing a thermoplastic composition comprising:

(a) a thermoplastic resin; and

(b) a calcium sulfate composition comprising a calcium sulfate present at a level of from 50 to 99 percent by weight based on the total weight of the calcium sulfate composition.

37. The tie of claim 36 wherein the thermoplastic resin is a polyolefin.

38. The tie of claim 36 wherein the thermoplastic composition also includes an epoxidized oil.

39. The tie of claim 36 wherein the thermoplastic composition includes the thermoplastic resin in an amount of from 40 to 75 percent by weight based on the total weight of the thermoplastic composition, the calcium sulfate composition in an amount of from 25 to 60 percent by weight based on the total weight of the thermoplastic composition, and the oil in an amount of from 0.5 to 2 percent by weight based on the total weight of the thermoplastic composition.

40. A process, for making a railroad tie from a fertilizer byproduct and plastic, comprising:

(a) admixing a fertilizer byproduct comprising a calcium sulfate composition with a thermoplastic resin, the calcium sulfate composition comprising a calcium sulfate present at a level of from 50 to 99 percent by weight based on the total weight of the calcium sulfate composition;

(b) melt processing the admixture to produce a thermoplastic composition; and

(c) forming the thermoplastic composition to produce a railroad tie.

41. The process of claim 40 further comprising admixing the fertilizer byproduct and the thermoplastic resin with an epoxidized soybean oil.

42. The process of claim 40 wherein the thermoplastic resin is a polyolefin.

43. The process of claim 42 wherein the polyolefin is selected from the group consisting of polyethylene and polypropylene.

44. A process for making a railroad track, the process comprising:

(a) making thermoplastic composite railroad ties from a thermoplastic composition comprising a calcium sulfate, a polyolefin resin, and an epoxidized oil,

(b) laying the ties on a raised rail bed; and

(c) placing rail on the ties.

45. The tie of claim 36 wherein the ties include holes for receiving carriage bolts for securing the rail to the ties.

46. The process of claim 44 wherein the composition comprises a yellow colorant.

47. The railroad tie of claim 36, wherein the tie has a top and a bottom, and the bottom is broader than the top.

48. A marine piling comprising:

(a) a core element comprising a thermoplastic composition comprising a thermoplastic resin and a filler, the core element having an outer surface; and

(b) a photoluminescent material adjacent the outer surface of the core element.

49. A marine piling comprising:

(a) a core element comprising a thermoplastic composition comprising a thermoplastic resin and a filler; and

(b) a sheath covering at least a portion of the element, the sheath comprising a second thermoplastic resin and a photoluminescent material.

50. The piling of claim 48 or 49 wherein the thermoplastic resin of the core element is a polyolefin.

51. The piling of claim 48 or 49 wherein the thermoplastic composition of the core element is made with a mixture which comprises an epoxidized soybean oil.

52. The piling of claim 48 or 49 wherein the filler comprises phosphogypsum (calcium sulfate) and/or fluorogypsum (calcium fluoride) present at a level of from 40 to 99 percent by weight based on the total weight of the composition.

53. The piling of claim 52 wherein the thermoplastic resin of the core element is present at a level of from 40 to 75 percent by weight based on the total weight of the thermoplastic composition, the phosphogypsum (calcium sulfate) or fluorogypsum (calcium sulfate) or Flue Gas Desulfurization gypsum or crude (calcium sulfate) or calcined gypsum (calcium sulfate) composition being present at a level of from 25 to 60 percent by weight based on the total weight of the thermoplastic composition of the core element, and comprising an epoxidized oil present at a level of from 0.5 to 2 percent by weight based on the total weight of the thermoplastic composition of the core element.

54. The piling of claim 49 wherein the sheath comprises a photoluminescent inner coating.

55. The piling of claim 49 wherein the thermoplastic resin of the sheath is transparent.

56. The piling of claim 49 wherein the sheath is annular and comprises (i) an admixture of a transparent thermoplastic resin and a photo-luminescent material and (ii) an inner coating of photoluminescent material.

57. The piling of claim 48 or 49 wherein the photoluminescent material is zinc sulfide.

58. The piling of claim 57 wherein the zinc sulfide is in crystal form.

59. The piling of claim 57 wherein the photoluminescent material emits light bright enough and long enough that the piling is visible to a normal human eye at a far enough distance to be useful at night.

60. The piling of claim 57 wherein the photoluminescent material emits the bright enough light for at least four hours.

61. The piling of claim 57 wherein the photoluminescent material emits the bright enough light for about 4-10 hours.

62. The piling of claim 48 or 49, having a density of at least 1.0 g/cm^3.

63. A bridge structure comprising a piling of any one of claims 48-62.

64. A product made by the process of any one of claims 1-11, 20-30, 40-44, and 46.